



(11) **EP 3 203 251 A3**

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
28.03.2018 Bulletin 2018/13

(43) Date of publication A2:
09.08.2017 Bulletin 2017/32

(21) Application number: **16201656.2**

(22) Date of filing: **01.12.2016**

(51) Int Cl.:
G01R 31/28 (2006.01) **H02H 9/04** (2006.01)
G01R 31/327 (2006.01) **G01R 31/12** (2006.01)
H02H 3/04 (2006.01) **H02J 1/00** (2006.01)
H02H 7/26 (2006.01) **G01R 31/02** (2006.01)
G01R 31/26 (2014.01) **H03K 17/082** (2006.01)
H03K 17/74 (2006.01) **H03K 17/0814** (2006.01)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **01.12.2015 US 201514955986**

(71) Applicant: **Hamilton Sundstrand Corporation**
Charlotte, NC 28217-4578 (US)

(72) Inventors:
• **DICKEY, John A.**
Caledonia, IL 61011 (US)
• **KILROY, Donald G.**
Rockford, IL 61108 (US)
• **SWENSON, Josh C.**
Rockford, IL 61107 (US)

(74) Representative: **Hughes, Andrea Michelle**
Dehns
St Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

(54) **SHARED TRANSIENT VOLTAGE SUPPRESSOR FOR PROTECTING MULTIPLE LOAD CHANNELS OF A SOLID STATE POWER CONTROLLER HAVING BUILT-IN-TEST CAPABILITY**

(57) Embodiments are directed to a transient protection circuit configured for use in a SSPC having a plurality of power channels. The transient protection circuit includes a shared transient voltage suppressor, and a shared protection line communicatively coupled to the shared transient voltage suppressor (360). The shared protection line (358) is configured to be communicatively coupled to and shared by the plurality of power channels. When the shared protection line is communicatively coupled to and shared by the plurality of power channels, energy above a threshold on any one of the plurality of power channels is dissipated through the shared protection line and the shared transient voltage suppressor.

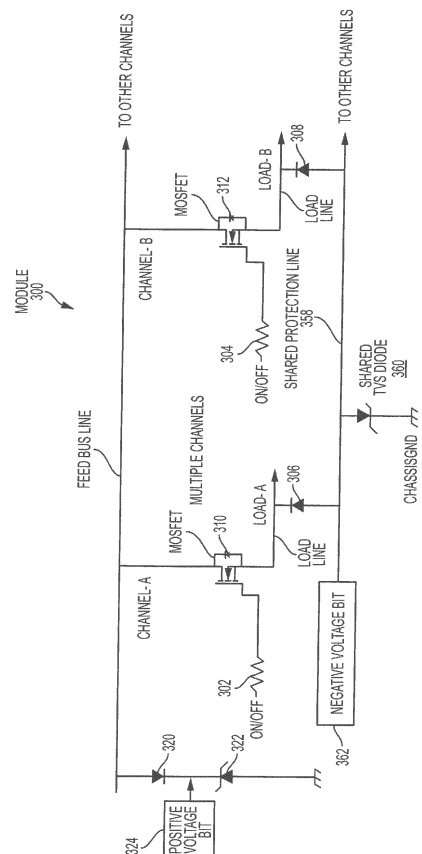


FIG. 3

EP 3 203 251 A3



EUROPEAN SEARCH REPORT

Application Number
EP 16 20 1656

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2015/270706 A1 (MEHL PETER C [US]) 24 September 2015 (2015-09-24)	1,4,5,7	INV. G01R31/28
Y	* paragraphs [0003], [0004], [0037], [0049], [0050]; figures 7,8 *	2,6,8	H02H9/04 G01R31/327 G01R31/12
Y	EP 2 479 860 A2 (HAMILTON SUNDSTRAND CORP [US]) 25 July 2012 (2012-07-25)	2,6,8	H02H3/04 H02J1/00
A	* abstract; figure 1 *	1,4,5,7	H02H7/26 G01R31/02
Y	DE 10 2011 012284 A1 (KNORR BREMSE SYSTEME [DE]) 30 August 2012 (2012-08-30)	2,6,8	G01R31/26 H03K17/082
A	* paragraphs [0002], [0003], [0008], [0010], [0023] - [0028] *	1,4,5,7	H03K17/74 H03K17/0814
X	US 2005/047048 A1 (CHIN HSU-YUAN [TW] ET AL) 3 March 2005 (2005-03-03)	1	
A	* paragraphs [0016], [0019]; figures 1,2,4 *	2-10	
A	US 2013/329329 A1 (LIU ZHENNING [CA] ET AL) 12 December 2013 (2013-12-12)	1-10	
	* paragraphs [0038], [0043]; figures 1,7 *		TECHNICAL FIELDS SEARCHED (IPC)
A	EP 2 207 245 A2 (HONEYWELL INT INC [US]) 14 July 2010 (2010-07-14)	1-10	G01R H02H H02J H03K B64D
	* paragraphs [0004], [0009]; figure 2 *		
A	CN 104 269 835 A (HUAWEI TECH CO LTD) 7 January 2015 (2015-01-07)	1-10	
	* the whole document *		
A	US 2015/123622 A1 (YASUI TSUTOMU [JP]) 7 May 2015 (2015-05-07)	1-10	
	* paragraphs [0077] - [0082]; figure 2 *		
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 15 February 2018	Examiner Wilhelm, Gunther
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>& : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.82 (P04C01)



5

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

10

Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

15

No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

20

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

25

see sheet B

30

All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

35

As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

40

Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

45

None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

50

55

The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 16 20 1656

5
10
15
20
25
30
35
40
45
50
55

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1, 2, 4-8

Transient protection circuit comprising a first current path on the load side for shunting excess voltage of a first polarity on the feed line side or on one of the load lines (of a multichannel power controller) via a de-coupling diode to a shared protection line and further through a shared transient voltage suppressor (which is common to all load lines) to ground, and a built-in-test, BIT, circuit for identifying a defect shared TVS.

2. claims: 3, 9, 10

Transient protection circuit comprising a second current path on the feed line side for shunting excess voltage of a second polarity on the feed line or on one of the load lines (of a multichannel power controller) through a series circuit consisting of a TVS diode and a non-TVS diode to ground. When claim 3 is dependent on claim 1, aspects relating to identifying a defect shared TVS are not defined. Claim 9 is silent on testing.

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 16 20 1656

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

15-02-2018

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015270706 A1	24-09-2015	NONE	
EP 2479860 A2	25-07-2012	EP 2479860 A2 US 2012187969 A1	25-07-2012 26-07-2012
DE 102011012284 A1	30-08-2012	CN 103460542 A DE 102011012284 A1 EP 2678912 A1 US 2014002100 A1 WO 2012113769 A1	18-12-2013 30-08-2012 01-01-2014 02-01-2014 30-08-2012
US 2005047048 A1	03-03-2005	NONE	
US 2013329329 A1	12-12-2013	NONE	
EP 2207245 A2	14-07-2010	EP 2207245 A2 US 2010172063 A1	14-07-2010 08-07-2010
CN 104269835 A	07-01-2015	CN 104269835 A EP 3185384 A1 WO 2016041377 A1	07-01-2015 28-06-2017 24-03-2016
US 2015123622 A1	07-05-2015	FR 3012922 A1 JP 2015112002 A US 2015123622 A1	08-05-2015 18-06-2015 07-05-2015